Tuna longline and tuna pole website contributions

1. History and description of the sector

Tuna longline:

Commercial longlining for tuna in South Africa has been documented since the 1960's with catches reaching ~2000 MT. Southern bluefin tuna and albacore comprised the bulk of the catch. The fishery ceased to exist after the mid 1960's, as a result of a poor market for low quality bluefin and albacore tuna landed by South African fishers. Interest to target tuna using longline gear re-emerged in 1995 when a joint venture with a Japanese vessel confirmed that tuna and swordfish could be profitably exploited within South Africa's waters. 30 experimental longline permits were issued in 1997 to target tuna. The main purpose of the fishery was to develop a large pelagic catch performance for South Africa such that South Africa could receive equitable quotas from the Regional Fisheries Management Organisations (RFMOs) such as the International Commission for the Conservation of Atlantic Tuna (ICCAT) and the Indian Ocean Tuna Commission (IOTC) and the Commission for the Conservation of Southern Bluefin Tuna (CCSBT). Catches peaked at over 2 500 t during the experimental phase of the fishery. However, swordfish comprised the bulk of the catch in each year. Targeting of swordfish has led to sharp declines in swordfish abundance in South Africa's EEZ.

50 long-term rights (10 year) were made available at the end of 2005; 17 rights were issued to the swordfish-directed fishery and 26 to the tuna-directed fishery (1 right = 1 vessel). The primary objectives of this allocation were to develop a tuna catch performance for South Africa and to South Africanise the fishery. Catches improved to > 3 500 t in 2005 with the assistance of foreign flag charters. However, none of the Asian flagged vessels reflagged South African and as a result no further provision was made for the use of foreign flag charters in 2006. Consequently catches declined to < 500 t. In 2007 foreign flagged vessels were allowed to fish in South Africa yet again to, a) improve the South Africa's catch performance, b) to transfer skills to South African crew and c) to eventually reflag South African. To date, there are on average 10 – 15 foreign-flagged vessels taking out permits to fish in South Africa each year.

In March 2011 the Department consolidated the tuna/swordfish longline fishery and the pelagic shark fishery. The 6 pelagic shark vessels were absorbed into the tuna/swordfish longline fishery. The decision to terminate the targeting of pelagic sharks was due to the following reasons: 1) both blue and mako are threatened species as described by the IUCN; 2) substantial pelagic shark by-catch is expected in the tuna/swordfish fisheries; 3) sharks are slow growing, mature late, have low fecundity which makes them more susceptible to over-fishing, and 4) concerns over ecosystem effects.

As tuna and swordfish are oceanic migrants, their stocks are fished by a number of nations. Consequently, the management of these stocks are the responsibility of RFMOs. ICCAT and the IOTC are responsible for conducting stock assessments, devising control measures and issuing country allocations for stocks in the Atlantic Ocean and Indian Ocean, respectively.

Tuna pole:

The tuna pole fishery has operated since 1980 and the fishing grounds are situated along the west coast of South Africa. The tuna pole fishery traditionally targets high volume, low value albacore *Thunnus alalunga* along the west coast of South Africa for canning. As there is little value adding the fishery operates on small profit margins. Since 2003, this sector has diversified with some vessels targeting low volume, high value yellowfin tuna *T. albacares* for sashimi markets. Due to the seasonality of tuna in South Africa's waters the tuna pole fishery was also allowed access to snoek *Thyrsites atun* and yellowtail *Seriola lalandi*. Access to these additional species has caused conflict with the traditional linefish sector. Some tuna pole operators in the past have exacerbated the situation by targeting these species only, with no or little performance on tuna. To reduce the conflict between these sectors it was decided that tuna pole access to yellowtail would only be by means of bag limits, i.e. 10 yellowtail per person per trip. A minimum vessel size was also stipulated, i.e. only vessels ≥ 10 m will be allowed into the fishery unless tuna performance is demonstrated. Access to snoek requires further deliberation.

The fishery is managed by a TAE of 200 vessels (3 600 crew) and 200 rights were made available in the long-term allocation process in 2005, as albacore (the primary target species) was considered under-exploited. Annual catches of albacore have fluctuated around 3 000 MT and is largely dependent on the availability of albacore in near-shore waters from October to May. Due to the seasonality of the fishery, up to 40% of Rights holders are involved in other sectors.

The four major contracting parties/ co-operating non-contracting parties/ fishing entities actively fishing for albacore in the South Atlantic are Chinese-Taipei, South, Brazil and Namibia. ICCAT is responsible for conducting stock assessments, devising control measures and issuing country allocations. The stock assessment conducted in 2011 determined TAC of 24 000 MT for the south Atlantic region. South Africa was allocated 10 000 MT to share with Namibia, and that is currently being managed on an Olympic type system.

2. Dominant and/or targeted species; bycatch species

Tuna longline targets:

- Bigeye tuna (Foreign-flagged vessels)
- Yellowfin tuna (Foreign-flagged vessels)

- Swordfish (Local vessels)

Tuna/swordfish longline bycatch:

- Blue sharks
- Mako sharks
- Seabirds (albatrosses and petrels)
- Turtles

Tuna pole targets:

- Albacore (high volume, low value)
- Yellowfin tuna (low volume, high value)

Tuna pole bycatch:

- Snoek
- Yellowtail

3. Processing (frozen, canned, bait etc), and markets (local or international)

The main countries exported to include Japan, Spain, the US and the UK. They are sent fresh or frozen (-60°C freezers onboard vessels) fish to be processed in factories for:

- fillets (yellowfin, bigeye and albacore). Yellowfin and bigeye are exported dressed.
- canneries (albacore and skipjack tuna). Exported whole. South Africa does not have canneries to process these fish ourselves.
- sushi (yellowfin, bigeye and southern Bluefin tuna). Exported dressed

Around 80% of our catch is exported depending on the quality of the catch and international markets. Fish of a lower quality are usually sold on the local market for less. Few fish are required in South Africa to fulfill the sushi and fillet markets.

4. Catch history – annual catches, spatial and temporal distribution of catches

A summary of dominant target and bycatch retained catches for the last 6 years are displayed in Figures 1 and 2. Notice the improvement in catches from 2006 to 2007 when foreign-flagged vessels were once again given permits to fish in South Africa's waters. The catches of blue and mako sharks increased from 2010 to 2011 when the pelagic shark vessels were consolidated with the tuna/swordfish longline fishery.

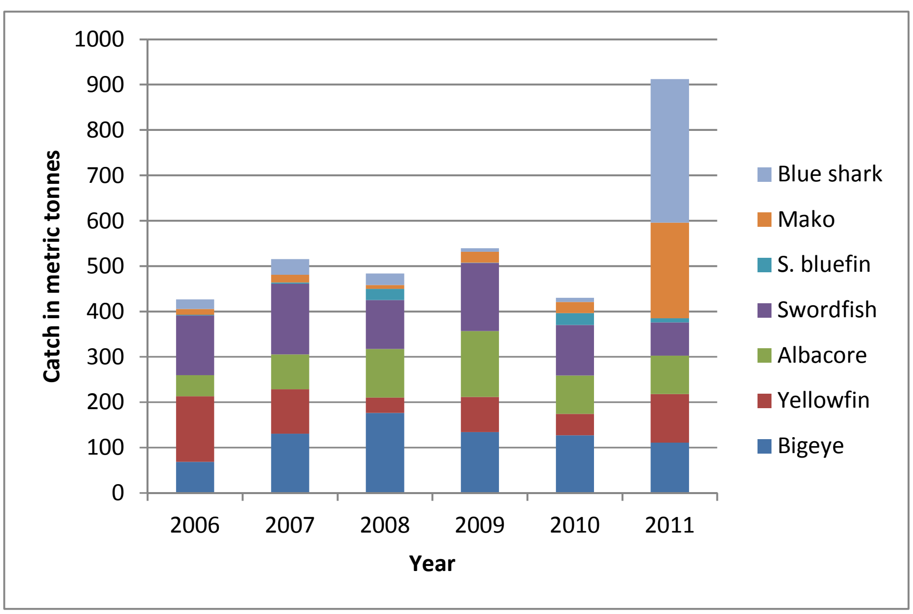


Figure 1. Retained tuna/swordfish longline catch from 2006 – 2011 in the Atlantic Ocean.

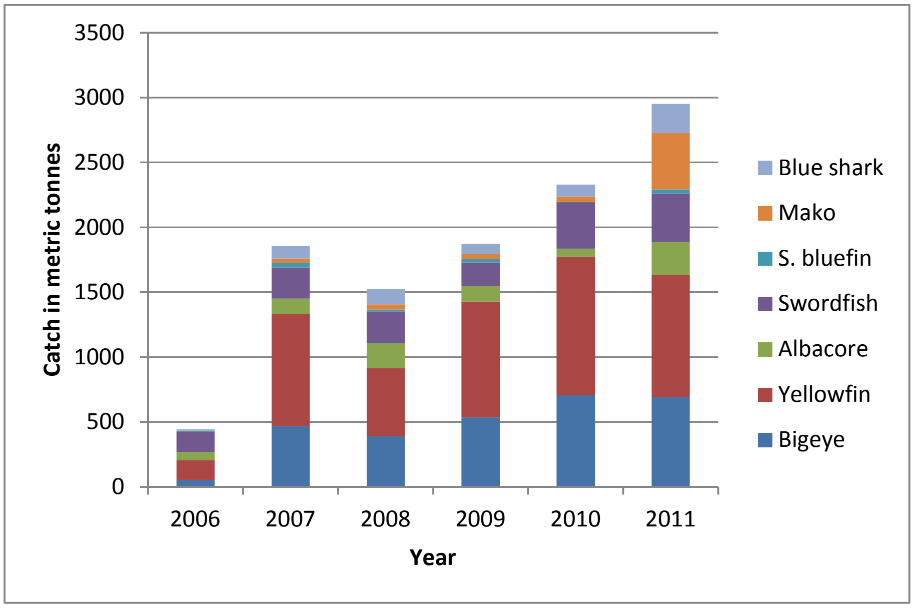


Figure 2. Retained tuna/swordfish longline catch from 2006 – 2011 in the Indian Ocean.

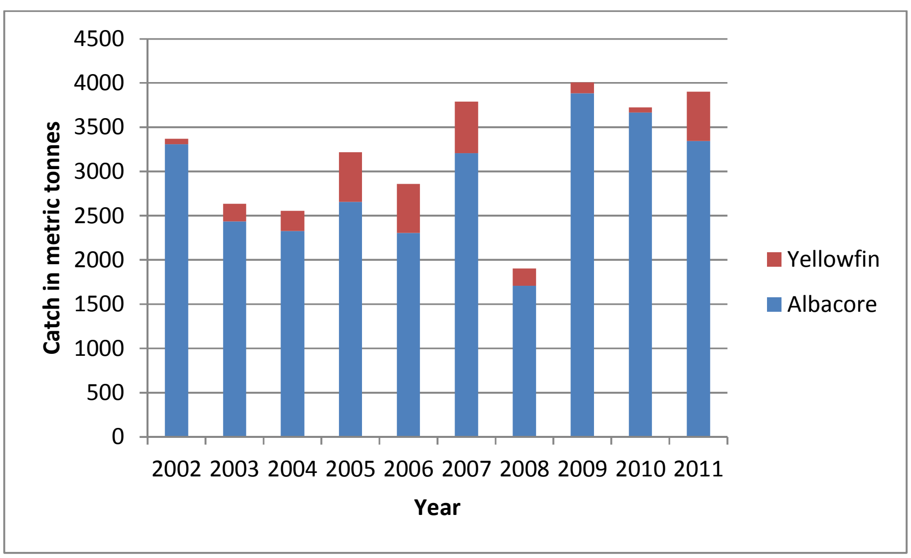


Figure 3. Retained tuna pole catch from 2002 – 2011 in Atlantic and Indian Oceans.

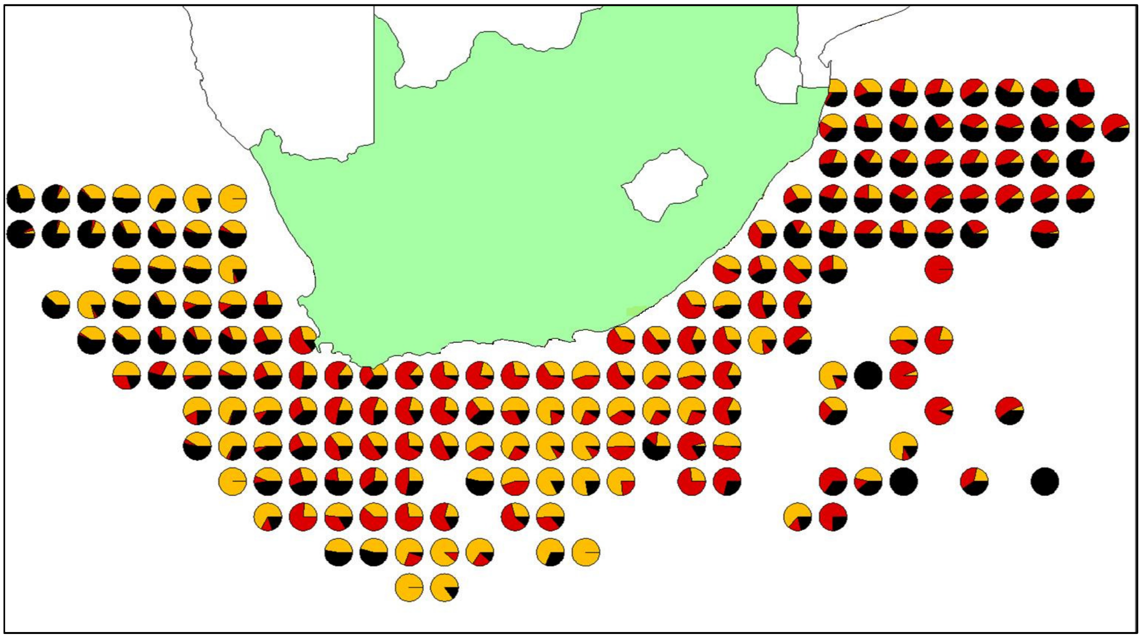


Figure 4. The average CPUE (kg per 1000 hooks) of bigeye (orange), yellowfin (red) and swordfish (black) from 2006 – 2011 per 1 x 1° grid block in the pelagic longline fishery.

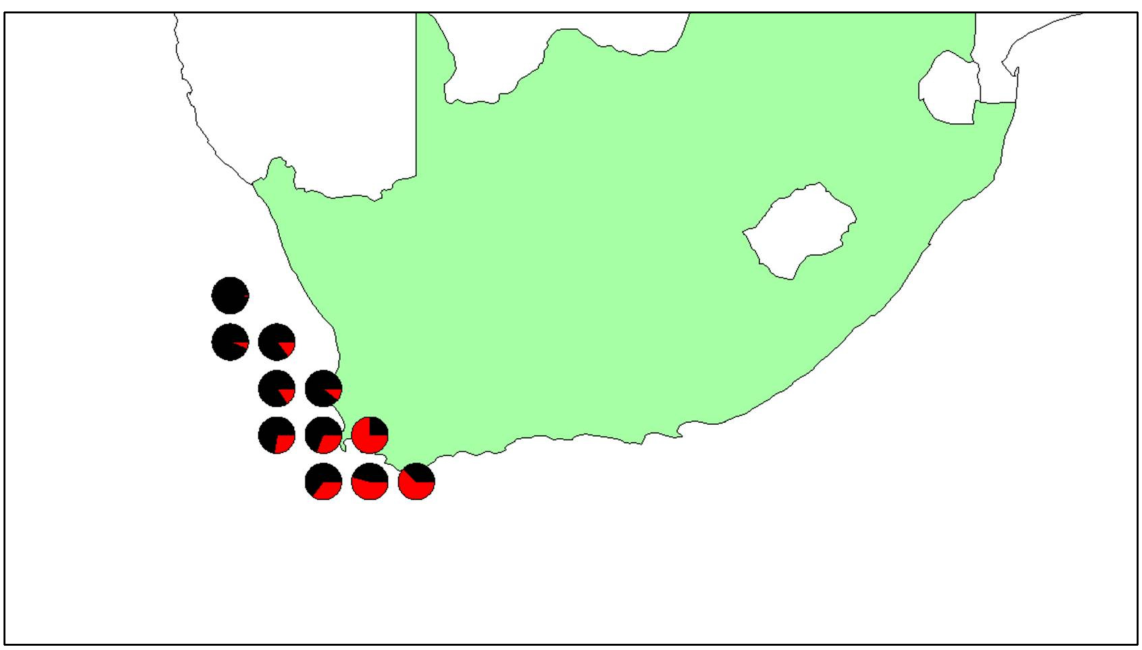


Figure 5. The average catch of albacore (black) and yellowfin tuna (red) from 2002 - 2010 per 1 x 1° grid block in the tuna pole fishery.

5. **Socioeconomics (annual value of landed and processed catch)**

   Markus Burgener's inputs…

   The price per kg varies based on the availability of fish on the market, the quality of the fish (overall meat quality, fresh/iced or frozen) and its destination. Average prices are the following:

   Albacore: R10 – R20/kg
   Yellowfin tuna: R30 – R50/kg
   Bigeye tuna: R50-80/kg
   Swordfish: R50/kg
   Southern Bluefin tuna: highest value. Varies considerably based on grading.

6. **Biological characteristics of dominant species (important by-catch species too?), including habitat and distribution, feeding, reproduction, age and growth, stock structure, others.**

Albacore species profile	
Family	Scombridae
Scientific Name	*Thunnus alalunga*
Common Names	Albacore, Longfin tuna, Longfin tunny, Albakoor, Langvin tuna
Global Distribution	Albacore is a highly migratory species with a wide geographical distribution. Populations are found in the Atlantic, Mediterranean, Indian and Pacific oceans (ICCAT, 2004). The species prefers cooler and deeper water from 19 – 21°C (Van Der Elst, 2010), though dependent on a minimal dissolved oxygen content of 3.7 ml/l (Graham *et al.* 1989)
South African Distribution	In South Africa schools of south Atlantic albacore occur in larger quantities along the temperate west coast than schools of Indian Ocean albacore along the warmer the south east coast (Penney, 1994)
Reproductive Style	Gonochorist
Breeding/Spawning Season	Spawning season for the south Atlantic stock is in spring-summer from September to March (ICCAT, 2004) and October to March for the Indian ocean stock (Chen *et al.* 2005)
Breeding/Spawning Locality	Spawning areas in the south Atlantic are off the eastern Brazilian coast (Beardsley 1969, Koto 1969). The main spawning area in the Indian Ocean occurs the waters off eastern Madagascar (Koto 1969, Shiohama 1985).
Movement	Migratory
Habitat - Adults	Albacore prefer cooler temperate
Habitat - Juveniles	Juvenile tuna from 2 to 35-40 cm FL are not caught and this life stage remains virtually unknown (ICCAT, 2004). From around 40 cm FL albacore start appearing in surface fisheries. The underdeveloped swim bladder in juveniles gives them limited vertical movement in the water column.
Habitat - Eggs/Larvae	Eggs and larvae are pelagic and widely distributed by ocean currents.
Feeding - Adults	Albacore are opportunistic top predators feding on schools of sardine, anchovy, mackerel and squid (ICCAT, 2004)
Feeding - Juveniles	Similar diet as adults with implications on their life history features of growth and survival.
Age at 50% Maturity	5
Length at 50% Maturity	90cm FL
Max Age	13
Max Weight	23kg
Max Length	130cm FL

Yellowfin tuna species profile	
Family	Scombridae
Scientific Name	*Thunnus albacares*
Common Names	Yellowfin tuna, Geelvin tuna, Yellowfin tunny
Global Distribution	A cosmopolitan species distributed in tropical and subtropical open waters of the three oceans. The geographical limits are 45°-50° N and S.
South African Distribution	The yellowfin that occur in South African waters may be from the Atlantic and/or Indian Ocean stock.
Reproductive Style	Gonochoristic. An intermediate pattern of reproduction implies an asynchronous development of the oocyte (Arocha *et al.* 2000). One female can lay between 5 and 60 million eggs per year (Cayré *et al*. 1988).
Breeding/Spawning Season	October to March in the eastern Atlantic (Bard *et al.* 1991).
Breeding/Spawning Locality	In the eastern Atlantic the equatorial area from the coasts of the Gabon (Gulf of Guinea) to 25 W is the main spawning area (Bard *et al.* 1991).
Movement	Migratory
Habitat - Adults	Adults can reach depths of 350m but prefer to stay at 100m. The water temperature usually does not drop more than 8°C relative to the surface temperature. It prefers temperatures of aound 22°C and dissolved oxygen content above 3.5ml/l-1 (Brill *et al.* 1999, Brill 1994 and Korsmeyer *et al.* 1996)
Habitat - Juveniles	More than 90% of its time is spent in depths around 100m and temperatures of around 22°C. Juveniles stay in the equatorial region in coastal areas.
Habitat - Eggs/Larvae	Eggs (0.9 - 1.04 mm in diameter) and larvae (2.7mm) are pelagic and widely distributed by currents.
Feeding - Adults	Adults are opportunistic top predators with a broad food spectrum, especially in habitats with low concentrations of organisms. Prey items include teleosts, squid, hyperrid amphipods, *Phrosina semilunata* and *Cubiceps pauciradiatus*.
Feeding - Juveniles	Juvenile yellowfin tuna feed prey on small mesopelagic fish, *Vinciguerria nimbari* (Roger and Marchal, 1994).
Age at 50% Maturity	2
Length at 50% Maturity	108.6cm FL
Max Age	8
Max Weight	200kg
Max Length	239cm FL

Bigeye tuna species profile	
Family	Scombridae
Scientific Name	*Thunnus obesus*
Common Names	Bigeye tuna, Bigeye tunny, Grootogg tuna
Global Distribution	Circumglobal in tropical and subtropical waters of the Atlantic, Indian and Pacific oceans. Absent from the Mediterranean (Collette and Nauen 1983).
South African Distribution	In SA this species shoals offshore and seldom approaches the coast (van der Elst 1993).
Reproductive Style	Gonochorist, multiple broadcast spawners
Breeding/Spawning Season	Spawning season from December to January and also in June in the eastern Indian Ocean (Nootmorn 2004). Spawning season in the south Atlantic (Congo-Angola) is from November to February (Rudomiotkina 1983). Bigeye spawning takes place mostly at night, estimated time from 18h00 to after midnight, depositing eggs daily (Matsumoto and Miyabe 2002).
Breeding/Spawning Locality	Bigeye tuna spawn in areas of increased biological productivity near the borders of localised eddies and local seamounts and frontal regions where temperatures are 25-260C (Rudomiotkina 1983, Kailola et al. 1993).
Movement	Migratory
Habitat - Adults	Adults (>100cm FL) are epi and mesopelagic in open waters. Factors affecting the distribution includes the depth of the deep scattering layer ('false bottom'), the temperature and the oxygen concentration (Maury 2005). Bigeye expose themselves to large temperature changes of up to 20°C, from 25°C at the surface layer to temperatures of ~5°C at 500 m depth. Clear diel patterns in vertical movements were shown with archival tagging, from 0-100 m during the day and 400-500 m at night (Brill et al. 2005). Bigeye can withstand a lower dissolved oxygen concentration than any other tuna species, as low as 1.5 ml/l (Musyl et al. 2003).
Habitat - Juveniles	Juveniles (30-70cm FL) occupy surface waters and are commonly found in schools at fish aggregating devices (FADs).
Habitat - Eggs/Larvae	Eggs and larvae are pelagic and are most frequently found in temperatures above 28°C where salinity is 33.8 - 36.0‰ (Ambrose 1996).
Feeding - Adults	Bigeye are opportunistic predators that feed on oceanic mesopelagic communities (migratory and non-migratory) such as cephalopods, euphausids and mesopelagic fishes (Bertrand et al. 2002, Dagorn et al. 2000). Vertical movement to forage in the deep scattering layer has been recorded (Dagorn et al. 2000).
Feeding - Juveniles	Juveniles have been recorded feeding on small-sized mesopelagic fish (*Vinciguerria nimbaria*).
Age at 50% Maturity	3
Length at 50% Maturity	100cm FL
Max Age	15
Max Weight	210
Max Length	250cm FL

Swordfish species profile	
Family	Xiphiidae
Scientific Name	*Xiphias gladius*
Common Names	Swordfish, Broadbill, Swaardvis
Global Distribution	An oceanic species found in all oceans, including the Mediterranean, Red Sea and North Sea (Heemstra and Heemstra, 2004)
South African Distribution	Most commonly found offshore but is sometimes seen in coastal waters, generally above the thermocline (Collette, 1995)
Reproductive Style	Gonochorist, multiple (batch) broadcast spawners
Breeding/Spawning Season	November to March in the South Atlantic. October to April in the Indian Ocean.
Breeding/Spawning Locality	Southern coast of Brazil between 20 and 30°S. Reunion Island.
Movement	Migratory
Habitat - Adults	Swordfish can tolerate a wide range of temperatures (5 - 27°C), the widest temperature tolerance than any billfish, but is often found in surface waters at temperatures over 13°C (Nakamura, 1985). They can dive to depths of up to 650m.
Habitat - Juveniles	Juvenile swordfish are commonly found in tropical and subtropical waters and migrate to higher latitudes as they mature (IOTC-SC14, 2011)
Habitat - Eggs/Larvae	Eggs are pelagic. Larvae are pelagic and often found in waters with temperatures above 24°C. They are generally a few meters below the surface but can sink to as deep as 30m at night (Nishikawa and Ueyanagi, 1974)
Feeding - Adults	Swordfish feed on a wide variety of prey including groundfish, pelagic fish, deep-water fish, and invertebrates (cephalopods being the preferred prey). They are believed to feed throughout the water column. The diet of swordfish is known to vary considerably, both geographically and seasonally (Anon, 2010)
Feeding - Juveniles	Juveniles will also opportunistically feed on fish and invertebrates. Larvae over 10mm feed almost exclusively on the larvae of other species.
Age at 50% Maturity	6-7 years
Length at 50% Maturity	156cm FL
Max Age	30+ years
Max Weight	650kg
Max Length	455cm FL

7. **Commercial Fishery: (What species are caught (Refer to [2]), catch areas (Refer to [4]), gear, effort, how are they processed (Refer to [3]), economics/fishery value (Refer to [5]?)**

Table 1. The number of hooks set in the tuna/swordfish longline fishery from 2006 – 2011 in the Indian and Atlantic Oceans.

	Number of hooks	
	Atlantic	**Indian**
2006	594080	442980
2007	1258559	3234084
2008	881153	3017020
2009	1036607	3441229
2010	619589	4470186
2011	805806	5342473

Table 2. The number of catch days in the tuna pole fishery from 2002 – 2010.

	Number of catch days
2002	2863
2003	1944
2004	2693
2005	2454
2006	2331
2007	3017
2008	1838
2009	2850
2010	2693

<u>Tuna longline gear and method description:</u>

Pelagic longline fishing involves the use of a main line of up to 150 km in length from which as many as 3,000 shorter branch lines, each with a baited hook, are dangled in the water column. The mainline is kept afloat by a series of buoys attached at intervals. The gear is passive, in that it captures any fish that happen to take the bait. Longlines operate mostly at depths between 100 m and 150 m, but can be set as deep as 300 m when targeting bigeye. Squid bait is generally used to target swordfish, and fish bait (pilchard, mackerel, maasbanker) for tunas. The line is set at night when fish are closer to the surface to feed and to reduce seabird bycatch and the line is left for up to 8 hours to soak. Light sticks are used by the swordfish-directed fishery and these are attached to the branch lines. Since very high quality fish is needed for sashimi, most vessels are equipped with "flash freezers" to freeze the fish to -60°C almost immediately.

Tuna pole gear and method description:

Pole and line fishing has been practiced for centuries in several different parts of the world. The method involves attracting a school of tuna to the side of a "bait-boat" by chumming, spraying water or throwing live bait (sardines and anchovies) overboard. This creates a tuna "feeding frenzy" and fish are hauled out of the water, one-by-one, using pole and line. Tuna can then be caught with feathers (in the shape of squid), baits or live bait. The catch consists predominantly of juvenile albacore and yellowfin though skipjack and bigeye may also be in the school.

8. Monitoring – Fisheries Dependent; data collection and collation, catch reporting and monitoring of landings, etc.

Permit conditions relevant to monitoring include the following:

- All fish have to be discharged in the presence of a Fishery Control Officer (FCO) who signs off on the landing declaration.
- The relevant IOTC, ICCAT and CCSBT catch statistical documentation for the exporting of fish has to accompany the catch.
- Catch statistic forms have to be filled out for every trip.
- Trip summaries are submitted after every trip.
- Every pelagic longline and tuna pole vessel has to be fitted with a functional vessel monitoring system (VMS), approved by the Department.
- Tuna pole vessels are requested to submit yellowfin tuna length frequency measurements with their catch statistic forms.

9. Monitoring – Fisheries Independent surveys, methods, timing, coverage, etc.

- 100% onboard observer coverage is achieved on the foreign-flagged pelagic longline vessels. Up until March 2011 when the DAFF funded observer programme ended, up to 20% observer coverage was achieved on local pelagic longline vessels. The tuna pole vessels were also monitored by observers during offloading up until that time.
- Monthly length frequency measurements are conducted by DAFF staff of tuna pole catches either in port or at freezer cold stores.

- Since the stock assessments and setting of quotas is the responsibility of the RFMOs, the research cruises on the Ellen Khuzwayo (Voyages in 2008, 2009, 2010 and 2011) do not directly deal with stock assessment type of sampling and data collection.

10. Assessment Strategy (eg. Per recruit, standardized cpue time series, age-structured assessment models)

The RFMOs (ICCAT, IOTC and CCSBT) conduct stock assessments of each species every two to three years, depending on the particular species stock status. It is generally up to each country to complete a standardised catch-per-unit-effort (CPUE) for the species/fishery. This is plugged into models such as age structured production models (ASPMs), stock synthesis (SS3), MultifanCL, A Stock Production Model Incorporating Covariates (ASPIC) etc. to ascertain the Maximum Sustainable Yield (MSY), B/B_{MSY}, SB/SB_{MSY}, F/F_{MSY} and to produce Kobe plots.

11. Management strategy (OMP, TAC or TAE?)

Tuna/swordfish longline:

The South African tuna/swordfish longline fishery is relatively new, with the first commercial rights allocated in 2005. The policy stipulated that the TAE be set at 20 swordfish-directed vessels and 30 tuna-directed vessels. In the allocation process 18 rights were issued for the swordfish-directed fishery and 26 for the tuna-directed fishery (1 right = 1 vessel). As large pelagic resources are highly migratory and fished by many nations, these resources are managed by RFMOs. South Africa received swordfish catch limits of 932 t for 2010, 962 t for 2011 and 1 001 t for 2012 from ICCAT. South Africa was also allocated southern bluefin quotas of 40 t from CCSBT for 2010 and 2011. Merging the Pelagic Shark fishery into the Large Pelagic (Tuna and Swordfish) fishery was realised in March 2011. Given that most tuna and tuna-like stocks are optimally- to over-exploited and that South Africa has a vessel capacity limit in the Indian Ocean the number of longline vessels targeting large pelagics has been restricted to 50 at this stage of development.

Tuna pole:

The primary objective for allocating long-term rights in the tuna pole fishery in 2006 was to improve or maintain catch performance of tuna, particularly albacore. Catch performance is the single most important criterion for the allocation of country quotas RFMOs like ICCAT. To achieve this objective a TAE of 200 vessels or a crew of 3 600, whichever is reached first, was made available for the 2006 allocation. However, in recent years an increasing proportion of the fishery has been targeting yellowfin tuna. The yellowfin tuna stock assessment conducted by ICCAT in 2011 indicated that the stock in the Atlantic Ocean is overfished and recommended that no additional effort be exerted on the Atlantic yellowfin stock to enable the stock to rebuild. Both ICCAT and IOTC are concerned over the stock status of yellowfin tuna. Furthermore, there is concern by the Department as to the origin of the yellowfin tuna caught by the tuna pole fishery. The albacore stock assessment conducted by ICCAT in 2011 indicated that for the stock to rebuild catches should not exceed 24 000t. However, South Africa should strive to fully utilise its 10 000 t shared quota with Namibia. The IOTC consider the albacore stock to be at risk of overexploitation. Given the above-mentioned concerns the TAE was frozen at the current effort levels. Lastly, to limit conflict with the traditional linefish sector on the snoek and yellowtail resources the minimum vessel size restriction of 10 m was maintained.

12. Subsistence Fishery (if applicable)

Not applicable.

13. Recreational Fishery (if applicable)

Within the tuna pole fishery there has been an emerging rod and reel component that targets large yellowfin tuna (> 45 kg dressed weight) south of Cape Town. South Africa also has a commercial linefish fishery which opportunistically catches albacore, yellowfin, king mackerel and shark in the Indian Ocean using rod and reel when linefish species such as kob, geelbek and slinger are not available. These catches usually only contribute to a small percentage of the total catch by the linefishery due to the multispecies nature of the fishery.

The recreational fishery uses rod and reel from ski-boats (5-8 m) to target numerous game fish, including yellowfin, king mackerel and billfish. Although catch and effort data are unknown for this fishery it is estimated that over 100 t of yellowfin and king mackerel are landed annually for the Atlantic and Indian Oceans combined. All recreational fishers are required to purchase a permit and are restricted to a bag-limit of 10 tuna, 5 swordfish and 5 billfish per day, with the sale of catch prohibited. There are further weight restrictions of 3.2 kg for yellowfin and bigeye, 6.4 kg for southern bluefin and 25 kg for swordfish caught.

14. Current Research (Description of various projects, each one clickable to produce box detailing objectives & responsible officer (brief background of responsible officer & contact details & publications)

The recent establishment of a large pelagic fishery represents an important milestone in the development of South African fisheries. However, research activities directed at the large pelagic species targeted by longline are in its infancy in South Africa and to date only four dedicated research trips have been undertaken since 2008.

- A general paper detailing the history and current status of the large pelagic fishery is planned for 2013.

- DAFF is collaborating with Natacha Nikolik and Jérôme Bourjea (Chairman of the Working Party on Billfish) from Institut français de recherche pour l'exploitation de la mer/French Research Institute for Exploitation of the Sea (IFREMER) on the GERMON project. The project aims to analyse the population structure of albacore between the south west Indian Ocean and Atlantic Ocean with the use of genetics.

  The project is running from April 2013 to December 2015. Through this collaboration we hope that South Africa can contribute towards a better understanding of the stock structure of albacore and to aid the RFMOs in managing the species better.

- Similar to the GERMON project, DAFF has swordfish genetic samples from the Indian and Atlantic regions of our waters. A genetic study to ascertain the structure between the two regions will be conducted in 2013.

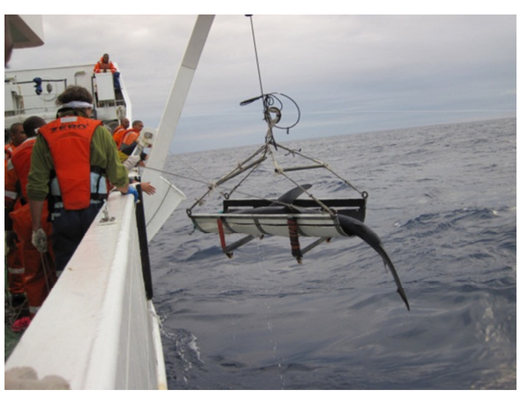
- The ageing of swordfish and albacore from this region of the Indian and Atlantic Ocean with the use of dorsal spines will be conducted in 2013.

- Stock assessment sessions for albacore and swordfish will be conducted by ICCAT in 2013. South Africa has to contribute standardised catch-per-unit-effort series for each species towards the sessions.

- The Department, with the assistance of NGOs (Birdlife SA) and universities, continue to assess the impact of longline fisheries on seabirds and investigate various mitigation and management measures. The Department continues to collaborate with WWF, University of Washington Seas Grant, and Birdlife SA to assess the impact of longline fisheries on seabirds, turtles and sharks and to investigate various mitigation and management measures. A National Plan of Action for seabirds was also published in 2008, which aimed to reduce seabird mortalities below 0.05 seabirds.1000hooks-1. Good collaboration with the fishing industry, researchers and managers, continual refining of mitigation measures, the implementation of stringent management measures through permit conditions, and close monitoring through the observer programme has resulted in seabird mortalities to decrease and the mortality rate in 2010 was 0.06 seabirds per thousand hooks and is almost at the goal identified in NPOA-seabirds.

- South Africa's involvement in the South West Indian Ocean Fisheries Programme (SWIOFP) through Component 4: Assessment and sustainable utilization of large pelagic resources has provided momentum to our research programme. The primary focus is to understand the distribution and movement of swordfish, bigeye and yellowfin tuna within the SWIO region, to which end 15 pop-up archival tags (PATs) have been provided for deployment on swordfish, yellowfin and bigeye tunas as well as hook monitors and time depth records for deployment of an instrumented longline. Prior to the inception of this project two bigeye tuna and four blue sharks have been tagged with PATs and 441 blue sharks with conventional tags.

In 2010, three yellowfin tuna were tagged with PAT tags provided by SWIOFP. The three tags popped up and transmitted data earlier than what they were programmed for, indicating that the animals had died prematurely and the tags had exceeded their depth limit of 1200m. The trends in the data are yet to be analysed



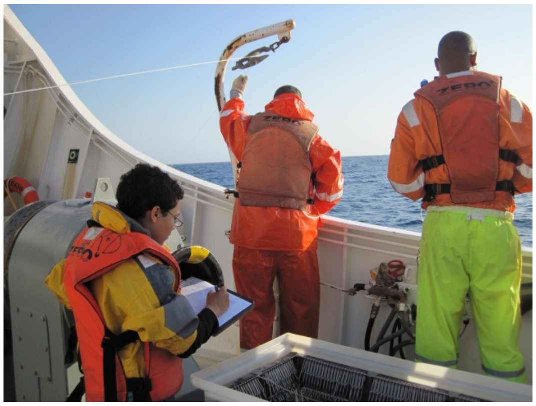
in detail to understand the cause of these premature pop-ups. Three blue sharks were also tagged with PAT tags in 2010 and a further two blue sharks were tagged with SPOT tags in 2011. The Department's national research cruise in 2011 was a momentous achievement during which 11 swordfish were successfully PAT tagged in the SWIO region with SWIOFP tags. Swordfish have proven to be very sensitive to handling and South Africa is the first country to achieve PAT tagging of swordfish in this region. Tags have been programmed for either 90 or 180 days. Of the 11 tags, 4 remained on the swordfish for more than 2 months. The results of this study were presented at the IOTC Working Party for Billfish in 2012 (Document number IOTC-2012-WPB10-16).

South Africa aims to conduct further research on the movement of large pelagic species between the Indian and Atlantic Oceans by placing more satellite (PSAT and SPOT) tags on animals as well as testing out the more affordable electronic spaghetti tags. Coupled with movement data, genetic studies on the difference between swordfish from the two Ocean basins will be explored.

- Rhodes University (Grahamstown) has collaborated with the Department to ascertain the stock delineation of yellowfin in the boundary region between the Indian and Atlantic Oceans by conducting genetic analysis and investigating movement patterns. The results, which form part of a MSc thesis, have yet to be released and verified.

- A study on exploratory live bait permits issued to the tuna pole sector is intended in 2013 to 2013. The aim of the study will be to review a live bait component in South Africa and to ascertain the effect live bait extraction will have on the Small Pelagics sector.

- South Africa has 3 years of instrumented longline data from the dedicated research cruises which should be analysed from 2013 onwards in a target and bycatch study.



15. Possibly contact details for scientist-in-charge? Ie "Further info"

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16. EAF considerations/status; priority issues, challenges, constraints

Seabirds:

South Africa has been collecting data on seabird interaction with its longline fishery since 1998. South Africa's NPOA for seabirds and was published in 2008. The NPOA-SEABIRDS specifies a maximum mortality rate of 0.05 birds/1000 hooks, and lays out bycatch mitigation measures for use in longline fishing. South Africa has introduced a number of bird mitigation measures through permit conditions since the start of its fishery, including the compulsory flying of tori-lines, no daylight setting, and use of thawed bait to improve sink rates, in the tuna fishery. South Africa does not consider the use of line shooters or offal discard management to be useful in reducing seabird incidental mortality. Furthermore, South Africa has developed a management plan to reduce seabird by-catch in its longline fishery in 2008. This plan includes a seabird limit per vessel per year that was implemented in 2008. Once a vessel reaches 25 birds killed in a year, it must adopt additional mitigation measures, it has to fly a second tori line and it has to place additional weights on to each branchline. Since the implementation of seabird mitigation measures and the stringent monitoring thereof seabird mortality rates has reduced by more than an order of magnitude. The current seabird mortality rate for 2012 is for the first time in history below the stipulated rate of 0.05 birds/1000 hooks.

Marine turtles:

The South African government has worked closely with WWF to educate skippers on release procedures for turtles. The use of circle hooks are encouraged as stated in the permit conditions, as well as releasing turtles with the use of a dehooker.

Sharks:

The Department has undertaken to terminate targeting of pelagic sharks due to the following reasons: 1) both blue and mako are threatened species as described by the IUCN; 2) substantial pelagic shark by-catch is expected in the tuna/swordfish fisheries; 3) sharks are slow growing, mature late, and have low fecundity which makes them more susceptible to over-fishing, and 4) concerns over ecosystem effects. Under current management, the bycatch limit has been set at 2 000t dressed weight. Once this limit is reached, fishing in the large pelagic fishery would stop. The domestic pelagic longline fishery originally only targeted tuna and swordfish, although shark by-catch was also recorded. Foreign pelagic tuna-directed fisheries are mostly comprised of Japanese vessels targeting offshore oceanic species such as mako sharks (*Isurus oxyrinchus*) and blue sharks (*Prionace glauca*). Species that may not be landed include the hammerhead, thresher, silky and oceanic whitetip sharks. A priority and challenge of the Department is to curb the targeting of pelagic sharks such as mako and blue sharks.

The NPOA for sharks has been redrafted and gazetted for public comment in August 2011. The Department is currently finalising this process.

17. References and further reading

Ambrose, DA. 1996. Scombridae: Mackerels and tunas, In Moser, H. G. (Ed.), The early stages of fishes in the Californian current region. CalCOFI, Atl. 33: 1270-1285.

Arocha, F., D.W. Lee, L.A. Marcano and J.S. Marcano. 2000. Preliminary studies on the spawning of yellowfin tuna, *Thunnus albacares*, in the western Central Atlantic. *Collect. Vol. Sci. Pap, ICCAT*, 51(2): 538-551.

AZTI. 2004. ICCAT Manual 2.1.4 Description of Albacore (ALB).

Bard, F.X. and E.D. Scott. 1991. Sept traverses transatlantiques d'albacores marques thons migrateurs ou sédentaires? *Collect. Vol. Sci. Pap, ICCAT*, 36(1): 205-222.

Beardsley, G. L. 1969. Proposed migrations of albacore, Thunnus alalunga, in the Atlantic Ocean. Transactions of the American Fisheries Society. 98(4): 589-598

Bigelow K. A., Musyl, M. K., Poisson, F. and Kleiberm, O. 2006. Pelagic longline gear depth and shoaling. *Fisheries Research* 77: 173 – 183

Brill R.W. 1994. A review of temperature and O2 tolerance studies of tunas pertinent to fisheries oceanography, movement models and stock assessments. *Fish. Oceanogr.*, 3: 204-216.

Brill R.W., B.A. Block, C.H. Boggs, K.A. Bigelow, E.V. Freund y D.J. Marcinek. 1999. Horizontal movements, depth distribution of large, adult yellowfin tuna (*Thunnus albacares*) near the Hawaiian Islands, recorded using ultrasonic telemetry: implications for the physiological ecology of pelagic fishes. *Marine Biology*, 133: 395-408.

Brilli, R. W, Bigelow, K. A., Musyl, M. K., Kerstin, A. F., Warrant, E. J. 2005. Bigeye tuna (*Thunnus obesus*) behaviour and physiology and their relevance to stock assessments and fishery biology. *Col. Vol. Sci. Pap (ICCAT*) 57(2): 142 – 161

Cayré, P., B. Amon Kothias, T. Diouf and J.M. Stretta. 1988. Biología de los atunes, En Fonteneau A., J. Marcillé (Eds.), Recursos, pesca y biología de los túnidos tropicales de Atlántico centro-oriental. *FAO Doc. Tec. Pesq*., 292, 391 pp

Chen, I-C, P-F Lee and W-N Tzeng. 2005. Distribution of albacore (Thunnus alalunga) in the Indian Ocean and its relation to environmental factors.

Collette BB, Nauen CE. 1983. Scombrids of the world. An annotated and illustrated catalogue of tunas, mackerels, bonitos and related species known to date. FAO species catalogue. FAO Fisheries Synopsis 125(2): 137pp.

Collette, BB. 1995. Xiphiidae. Peces espada. p. 1651-1652. In W. Fischer, F. Krupp, W. Schneider, C. Sommer, K.E. Carpenter and V. Niem (eds.) Guia FAO para Identification de Especies para lo Fines de la Pesca. Pacifico Centro-Oriental. 3 Vols. FAO, Rome.

Dagorn, L, Bach, P, Josse, E. 2000. Movement patterns of large bigeye tuna (*Thunnus obesus*) in the open ocean, determined using ultrasonic telemetry. Mar. Biol. 136(2): 361-371.

Graham, J. B., W. R. Lowell, N. Chin Lai and R. M. Laurs. 1989. O2 tension, swimming velocity, and thermal effects on the metabolic rate of the Pacific albacore, *Thunnus alalunga. Exp. Biol.*, 48: 89-94.

Heemstra, P, Heemstra, E. 2004. Coastal Fishes of Southern Africa. National Inquiry Services Centre (NISC) and South African Institute for Aquatic Biodiversity (SAIAB), Grahamstown. 415pp

Kailola PJ, Williams, MJ, Steward, PC, Reichelt, RE, McNee, A, Grieve, C. 1993. Australian Fisheries Resources. Bureau of Resource Sciences, Department of Primary Industries and Energy, and the Fisheries Research and Development Corporation, Canberra, Australia. 422pp.

Korsmeyer K.E., H. Dewar, N.C. Lai and J.B. Graham. 1996. Tuna aerobic swimming performance: physiological and environmental limits based on oxygen supply and demand. *Comp. Biochem. Physiol*. 113B: 45-56.

Koto, T. 1969. Studies on the albacore-XIV. Distribution and movement of the albacore in the Indian and the Atlantic Oceans based on the catch statistics of Japanese tuna longline fishery. *Bull. Far Seas Fish. Res. Lab*. 1:115–129.

ICCAT. 2011. Report of the 2011ICCAT south Atlantic and Mediterranean albacore stock assessment sessions. Madrid, Spain, July 25 - 29.

IOTC–SC14 2011. Report of the Fourteenth Session of the IOTC Scientific Committee. Mahé, Seychelles, 12–17 December 2011. IOTC–2011–SC14–R[E]: 259 pp.

Matsumoto, T, Miyabe, N. 2002. Preliminary report on the maturity and spawning of bigeye tuna *Thunnus obesus* in the Central Atlantic Ocean. Collect. Vol. Sci. Pap, ICCAT, 54(1): 246-260.

Musyl M.K, R.W. Brill, C.H. Boggs, D.S Curran, T.K. Kazama and M.P. Seki 2003. Vertical movements of bigete tuna (Thunnus obseus) associated with islands, buoys and seamounts near the main Hawaian islands from archival tagging data. Fish. Oceanogr. 12:152-169

Nakamura I. 1985. FAO species catalogue. Vol. 5. Billfishes of the world. An annotated and illustrated catalogue of marlins, sailfishes, spearfishes and swordfishes known to date. FAO Fish. Synop. 125(5):65 p

Nishikawa, Y, Ueyanagi, S.1974. The distribution of the larvae of swordfish, *Xiphias gladius*, in the Indian and Pacific oceans. p. 261-264. In Proceedings of the international billfish symposium, Kailua-Kona, Hawaii, 9-12 August, 1972. Part. 2. Review and contributed papers. US Department of Commerce, NOAA Technical Report, NMFS SSRF 675.

Nootmorn, P. 2004. Reproductive biology of bigeye tuna in the eastern Indian Ocean. IOTC–2004–WPTT04–05.

Penney, A. J. and Punt, A. E. 1993. The South African Tuna Fishery: past, present and future. In: L.E Beckley and R.O van der Elst [Ed.] *Fish, Fishers and Fisheries. ORI Spec. Publ. 2*: 140 - 142

Penney, A. J. 1994. Morphometric relationships, annual catches and catch-at-size for south Atlantic albacore (*Thunnus alalaunga*). *Col.Vol.Sci.Pap. ICCAT*, 42 (1) : 371-382 (1994)

Penney, A. J., Yeh, S-Y., Kuo, C-L., Leslie, R. W. 1998. Relationships between albacore (*Thunnus alalunga*) stocks in the southern Atlantic and Indian Oceans. *Col. Vol. Sci. Pap (ICCAT*) 50(1): 261 – 271

Penney, A. J. and Griffiths, M. H. 1999. A first description of the developing South African longline fishery. *Col. Vol. Sci. Pap (ICCAT)* 49(4): 162 - 173

Petersen, S. L. Honig, M. B., Ryan P. G. and Underhill, L. G. 2009. Seabird bycatch in the pelagic longline fishery off southern Africa. *African Journal of Marine Science* 31: 205 - 214

Petersen, S. L. Honig, M. B., Ryan P. G., Underhill, L. G. and Compagno , L. J. V. 2009. Pelagic shark bycatch in the tuna- and swordfish-directed longline fishery off southern Africa. *African Journal of Marine Science* 31: 215 - 226

Roger C. and E. Marchal. 1994. Mise en évidence de conditions favorisant l’abundance des albacores, *Thunnus albacares*, et des listaos, *Katsuwonus pelamis*, dans l’Atlantique Equatorial Est. *Collect. Vol. Sci. Pap, ICCAT*, 42(2): 237-248.

Rudomiotkina, GP. 1983. Areas, periods and conditions of bigeye tuna, *Thunnus obesus*(Lowe), spawning in the tropical part of the Atlantic Ocean. Collect. Vol. Sci. Pap, ICCAT, 18(2): 355-362.

Shiohama, T. (1985) Overall fishing intensity and length composition of albacore caught by long line fishery in the Indian Ocean, 1952–1982. *IPTP TWS/85/22* 91–109.

Sun, C-L., Ehrhardt, N.M., Porch, C. E. and Yeh, S-Z. 2002. Analyses of yield and spawning stock biomass per recruit for the South Atlantic albacore (Thunnus alalunga). *Fisheries Research* 56:193 – 204

van der Elst RP. 1993. A Guide to the Common Sea Fishes of Southern Africa (3rd Edition). Struik Publishers Ltd. Cape Town, South Africa, 398pp.